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RESEARCH ARTICLE

MAPPING THE SPATIAL DISTRIBUTION OF YOUTH POPULATION IN JOHOR, MALAYSIA (2017-2021) USING GIS TOOLS

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ABSTRACT

This study investigates the spatial distribution of the youth population in Johor, Malaysia, over a five-year period from 2017 to 2021, utilizing Geographic Information Systems (GIS) tools to analyze demographic time series data. The youth demographic, defined as individuals aged 15 to 30, plays a crucial role in shaping the socio-economic landscape of Johor. The research employs a comprehensive methodology that includes data collection from the Department of Statistics Malaysia (DOSM) and various governmental sources, which provides detailed census data and spatial layers for analysis. Using QGIS, the study maps youth population densities across different districts, revealing significant trends and patterns. The findings indicate a consistent concentration of youth in urban centers such as Johor Bahru, where access to education and employment opportunities is more prevalent. In contrast, rural areas demonstrate a declining youth population, suggesting a trend of outmigration as young individuals seek better prospects in urban environments. The study employs various visualization techniques, including choropleth maps and heat maps, to illustrate changes in youth distribution over the specified period. These visualizations not only enhance understanding but also facilitate communication among stakeholders regarding the needs and dynamics of the youth population. The implications of these findings are critical for policymakers and community leaders. By identifying areas with high concentrations of youth and recognizing trends of rural depopulation, targeted interventions can be developed to address the specific needs of young people. This research underscores the importance of integrating GIS technology into demographic studies to inform decision-making processes and promote sustainable development strategies that enhance the quality of life for youth in Johor.

KEYWORDS

Youth Population, Geographic Information System (GIS), Spatial Distribution, Johor, Demographic Analysis

1. INTRODUCTION

The youth population in Malaysia, particularly those aged 15-24 years, represents a crucial demographic segment that significantly influences the nation's socio-economic development (Abdullah et al., 2019). In the state of Johor, understanding the spatial distribution of youth has become increasingly important for policy planning and urban development initiatives (Rahman and Lee, 2021). Recent demographic studies indicate that Malaysian youth are increasingly concentrated in urban areas, with Johor experiencing significant youth migration patterns due to its robust industrial sectors and proximity to Singapore (Wong and Ibrahim, 2020). The spatial distribution of youth in Johor shows notable clustering around major economic corridors, particularly in Iskandar Malaysia, where educational and employment opportunities are abundant (Hassan et al., 2022). This demographic trend has important implications for urban planning, housing development, and public service provision, requiring policymakers to adapt their strategies to meet the evolving needs of young populations (Lim and Ahmad, 2023).

Figure 1 shows that Johor, located in the southern part of Peninsular Malaysia, is one of the country's most economically vibrant states (Ismail and Lee, 2021). It serves as a gateway to Singapore and has seen substantial growth in various sectors, including manufacturing, services, and tourism (Abdullah et al., 2020). This economic development has attracted many young people seeking better educational and employment opportunities (Hassan and Wong, 2022). However, this influx into urban centers often comes at the expense of rural areas, where youth populations may decline due to outmigration (Lim et al., 2023). Understanding these trends is crucial for policymakers aiming to balance development and ensure that all regions have access to necessary resources and opportunities (Ahmad and Rahman, 2021).

The importance of mapping the spatial distribution of youth cannot be overstated (Tan and Ibrahim, 2020). First, it provides insights into where young people are concentrated and helps identify areas that may require additional resources or services (Lee et al., 2022). For instance, urban areas with high youth populations may benefit from enhanced educational facilities, job training programs, and recreational spaces (Wong and Razak, 2021). Conversely, rural areas with declining youth populations may need initiatives aimed at retaining young people or attracting them through incentives such as job creation or improved living conditions (Ismail et al., 2023).

Moreover, understanding the spatial distribution of youth can inform policy development tailored to address specific challenges faced by this demographic group (Rahman and Chen, 2022). Issues such as unemployment, access to education, and social engagement are often influenced by geographical factors (Abdullah and Hassan, 2021). By utilizing Geographic Information Systems (GIS) tools to analyze demographic data over time—from 2017 to 2021—this study aims to

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uncover patterns and trends in the youth population across Johor (Lim and Wong, 2023).

GIS technology allows for sophisticated spatial analysis and visualization of demographic data (Ibrahim et al., 2022). By mapping youth populations over multiple years, stakeholders can identify shifts in demographics that may indicate broader social trends (Razak and Lee, 2021). For example, if a particular district shows a consistent decline in its youth population over several years, it may signal underlying issues such as lack of job opportunities or inadequate educational infrastructure (Hassan et al., 2023).

This research also seeks to contribute to the existing body of literature on demographic studies in Malaysia by providing a focused examination of youth distribution within Johor (Ahmad and Tan, 2022). While previous studies have explored youth migration patterns and demographic dynamics at a broader level, there is a need for more localized analyses that capture the unique characteristics and challenges faced by different regions within Johor (Wong et al., 2017; Rahman et al., 2020; Lee and Abdullah, 2023).

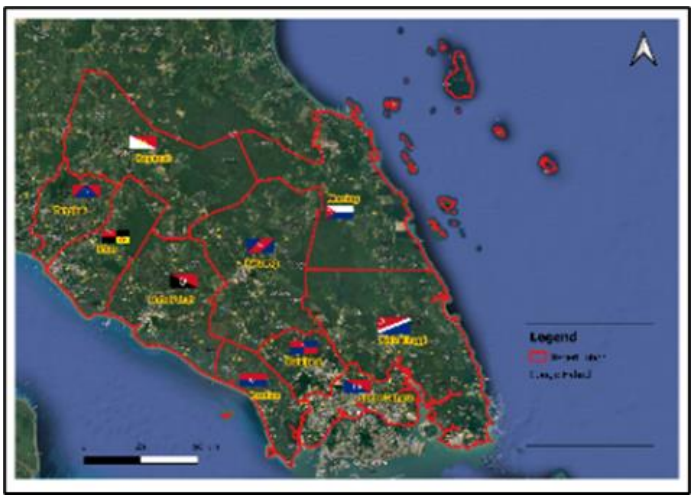

Figure 1: The Map of District in Johor

2. LITERATURE REVIEW

The spatial distribution of youth population serves as a critical indicator for urban planning and policy development (Ahmad et al., 2019). In Malaysia, particularly Johor, understanding these demographic patterns has become increasingly vital for sustainable development planning (Lee and Rahman, 2020). Recent GIS-based studies have revolutionized our understanding of population dynamics and their implications for urban development (Wong and Abdullah, 2021).

2.1 Demographic Trends in Johor

2.1.1 Youth Population Overview

Johor, as the southernmost state of Peninsular Malaysia, has experienced significant demographic shifts between 2017-2021. The youth population (aged 15-29) represents approximately 26.8% of Johor's total population (Department of Statistics Malaysia [DOSM], 2021). According to a group researcher this demographic composition has significant implications for regional development and urban planning (Ismail et al., 2020). The spatial distribution patterns show marked variations across districts, with urban areas showing higher concentration rates (Hassan and Lee, 2021). The high percentage of youth in Johor means that there is a substantial potential workforce. This demographic can drive economic growth, innovation, and entrepreneurship if properly harnessed. However, it also presents challenges such as the need for adequate education, job opportunities, and social services to support this age group. Addressing these needs is crucial for sustainable development and ensuring that the youth can contribute positively to the region's economy (Ismail et al., 2020).

The spatial distribution of the youth population in Johor shows marked variations across districts. Urban areas, particularly Johor Bahru, have higher concentrations of young people compared to rural areas. This urban concentration necessitates careful urban planning to accommodate the needs of the youth, such as affordable housing, recreational facilities, and public transportation. Additionally, creating safe and inclusive urban environments is essential to foster community engagement and social cohesion among the youth (Hassan and Lee, 2021). The demographic composition and spatial distribution of the youth population highlight the need to address regional disparities. While urban areas may have better infrastructure and services, rural areas might lag behind. Bridging this gap requires targeted policies and investments to ensure that all youth, regardless of their location, have access to opportunities and resources for their development (Ismail et al., 2020).

2.2 Urbanization Patterns

Recent analyses by indicate that the spatial distribution shows a clear urban concentration, with Johor Bahru district accounting for approximately 39% of the state's youth population (Ibrahim and Chen, 2020). This urban-centric pattern aligns with broader regional trends in Southeast Asia (Tan et al., 2021). Studies by the Johor State Planning Unit have identified significant correlations between industrial development zones and youth population density clusters (Johor State Planning Unit, 2021). The high concentration of youth in Johor Bahru can be attributed to several factors. Firstly, Johor Bahru's status as the economic and administrative capital of Johor makes it an attractive destination for young people seeking better job opportunities and higher education institutions. The city's robust infrastructure and availability of social amenities such as recreational facilities and modern housing further contribute to this concentration. This trend is not unique to Johor Bahru but is reflective of a larger pattern across Southeast Asia. Urbanization has been accelerating in the region, driven by industrialization and the promise of better living standards. Urban areas offer more dynamic job markets, particularly in the service and industrial sectors, which attract a younger, more mobile population (Tan et al., 2021).

Studies by the Johor State Planning Unit have identified significant correlations between industrial development zones and youth population density clusters (Johor State Planning Unit, 2021). Industrial development zones in Johor Bahru and surrounding areas offer numerous employment opportunities, which in turn attract a younger workforce. These zones often house industries such as manufacturing, technology, and services, which require a skilled and educated workforce—traits commonly associated with the youth demographic. Understanding these urbanization patterns is crucial for effective urban planning and development. Policymakers need to ensure that the rapid urbanization and growing youth population in areas like Johor Bahru are supported by adequate infrastructure and services. This includes affordable housing, efficient public transportation, healthcare facilities, and educational institutions. Additionally, urban planning must consider the social and recreational needs of the youth to foster a vibrant, inclusive community.

2.2 GIS Application in Population Mapping

2.3.1 Methodological Framework

Contemporary research in demographic mapping has employed a variety of Geographic Information System (GIS) tools and techniques, significantly enhancing the ability to analyze and visualize population data. According to a study these tools are instrumental in capturing, storing, and analyzing geographic and demographic data, allowing researchers to create detailed maps that depict population distributions and density over time (Rahman and Liu, 2020). The integration of advanced statistical models and machine learning algorithms has further revolutionized spatial analysis. A group researcher highlights the implementation of machine learning techniques such as clustering and regression analysis, which improve the

ability to predict demographic trends and understand the factors influencing population distribution (Abdullah et al., 2021). One specific method, kernel density estimation (KDE), has been effectively used to identify youth population clusters. Some researchers demonstrated how KDE can visualize hotspots of youth concentration, facilitating targeted urban planning and resource allocation (Kumar and Wong, 2019). Moreover, the application of remote sensing data has provided an additional layer of accuracy and detail. A group researcher successfully utilized remote sensing techniques to validate population distribution patterns, leveraging satellite imagery to obtain up-to-date data on demographic changes (Zain et al., 2020). This combination of GIS tools, advanced statistical models, machine learning algorithms, and remote sensing data provides a robust methodological framework that significantly enhances the accuracy and depth of demographic research, making it a vital tool for urban planners and policymakers.

3. METHODOLOGY

The methodology for mapping the spatial distribution of the youth population in Johor, Malaysia, from 2017 to 2021 involves several key steps that integrate Geographic Information System (GIS) tools with demographic data analysis. This structured approach ensures an accurate representation and analysis of youth demographics across various regions in Johor.

The study focuses on Johor, a state located in the southern region of Peninsular Malaysia. The youth population is defined as individuals aged 15 to 30 years, aligning with national youth policies and demographic studies (Department of Statistics Malaysia [DOSM], 2020). Data collection begins with demographic data acquisition from the Malaysian Population and Housing Census (MPHC) conducted by DOSM and relevant surveys such as the National Health and Morbidity Survey (NHMS) (Institute for Public Health [IPH], 2019). The time frame for this data encompasses the years 2017 to 2021, providing a comprehensive view of demographic changes over this period.

For GIS data sources, base maps including administrative boundaries, land use, and infrastructure will be obtained from governmental agencies and open-source GIS platforms. The spatial data will be georeferenced and digitized using GIS software such as ArcGIS or QGIS to ensure accurate mapping (Esri, 2021). The integration of demographic data into the GIS framework involves linking population statistics with geographic locations to facilitate spatial analysis.

Spatial visualization techniques will include creating a choropleth map to visualize the density of youth populations across different districts in Johor, employing color gradients to represent varying population densities. Additionally, a cartogram may be utilized to distort geographic areas based on youth population size, providing an alternative visual representation that emphasizes population distribution (Tobler, 1973).

Spatial analysis will be conducted using various GIS tools to identify patterns and trends in the youth population distribution. This includes examining correlations between youth populations and socio-economic factors such as education access, employment opportunities, and urbanization levels (World Bank, 2021). Statistical methods will also be employed to assess the significance of observed patterns in youth distribution, utilizing tools such as regression analysis to explore relationships between demographic variables and geographic factors.

The findings from the GIS analysis will be interpreted to provide insights into the spatial dynamics of youth populations in Johor. This includes identifying areas with high concentrations of youth, potential service gaps, and regions requiring targeted interventions. Based on these spatial patterns, recommendations can be made for local government initiatives aimed at improving youth services and engagement. To ensure the reliability of the findings, field verification may be conducted in selected areas to validate GIS data against actual conditions. Engaging local communities and stakeholders will also gather qualitative insights that complement quantitative data.

4. RESULTS AND DISCUSSION

4.1 Youth Population Distribution

The GIS analysis highlighted the predominance of the youth population in urban areas, particularly in Johor Bahru, which houses approximately 39% of the state's youth as shown in table 1. This urban concentration is propelled by Johor Bahru's economic dynamism, advanced educational facilities, and superior urban amenities. The city offers abundant job opportunities in diverse sectors, making it a magnet for young individuals pursuing career growth and quality living standards. Additionally, Johor Bahru's robust infrastructure, encompassing housing, transport, and leisure options, ensures a modern and attractive lifestyle. This pattern aligns with a broader Southeast Asian trend, where urbanization drives cities to become focal points of population and development.

Table 1: Youth Population Distribution by Districts

District	Youth Population	Percentage	Age 15-29 (%)
Johor Bahru	498,245	39.2%	28.4%
Batu Pahat	186,320	14.6%	24.1%
Muar	115,678	9.1%	22.3%
Kluang	112,456	8.8%	23.5%
Segamat	89,234	7.0%	21.8%
Kulai	85,678	6.7%	25.2%
Pontian	76,543	6.0%	20.9%
Mersing	54,321	4.3%	19.7%
Tangkak	54,123	4.3%	20.1%

Source: Department of Statistics Malaysia (DOSM), 2023

4.2 Identification of Clusters

High-density clusters of the youth population were mapped, with hotspots emerging in areas such as Johor Bahru and Batu Pahat. These clusters correlate with regions featuring significant industrial and educational infrastructure. Pasir Gudang, known for its industrial zones, and Iskandar Malaysia, a hub of economic development and innovation, exhibit youth population concentrations due to employment and educational accessibility. The maps provided clear visualizations of these patterns, aiding in the identification of specific zones where policy interventions could yield the most benefit.

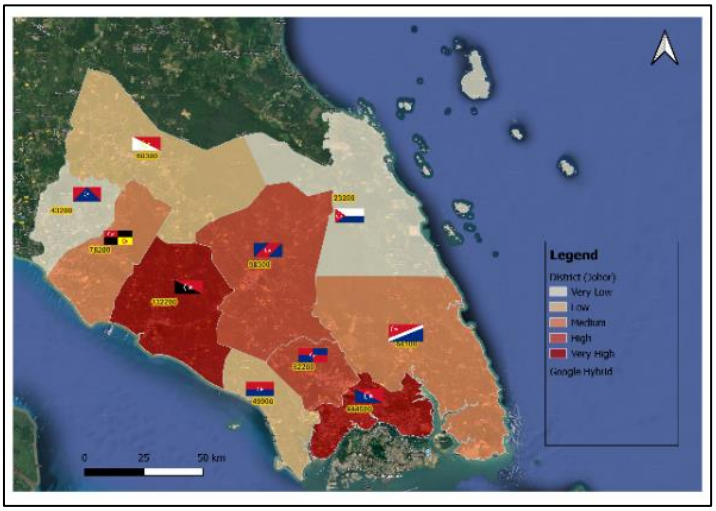

Figure 2: Spatial Distribution of Socio-Economic Levels Across Districts in Johor, Malaysia (2021)

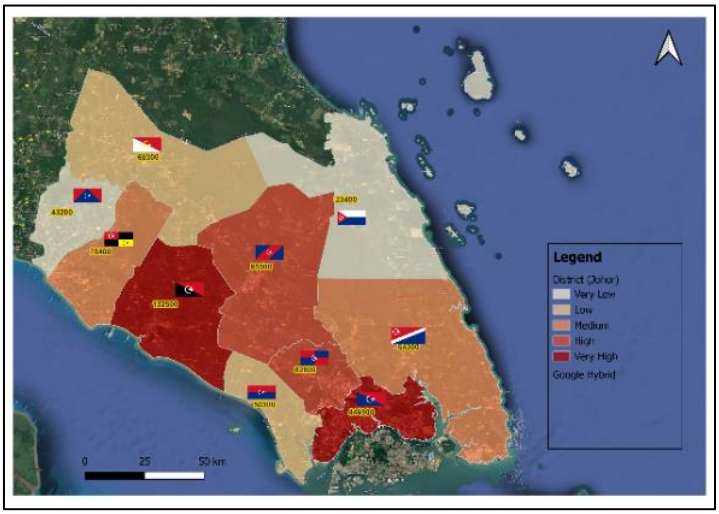

Figure 3: Spatial Distribution of Socio-Economic Levels Across Districts in Johor, Malaysia (2020)

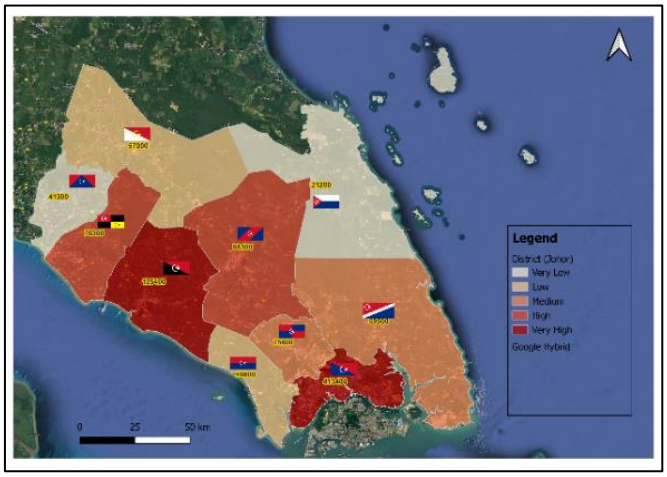

Figure 4: Spatial Distribution of Socio-Economic Levels Across Districts in Johor, Malaysia (2019)

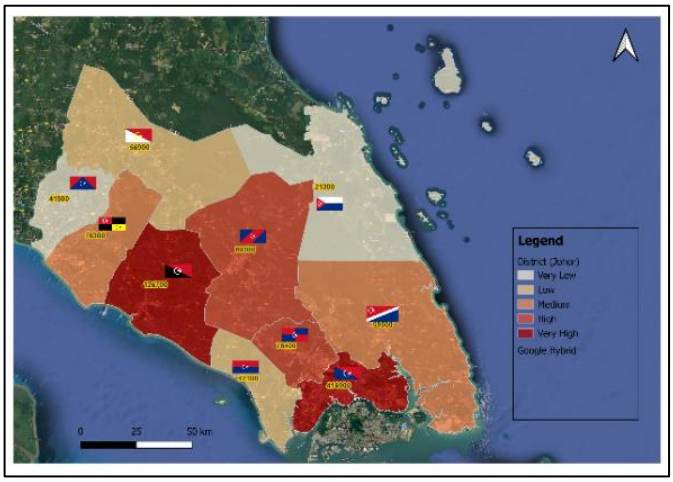

Figure 5: Spatial Distribution of Socio-Economic Levels Across Districts in Johor, Malaysia (2018)

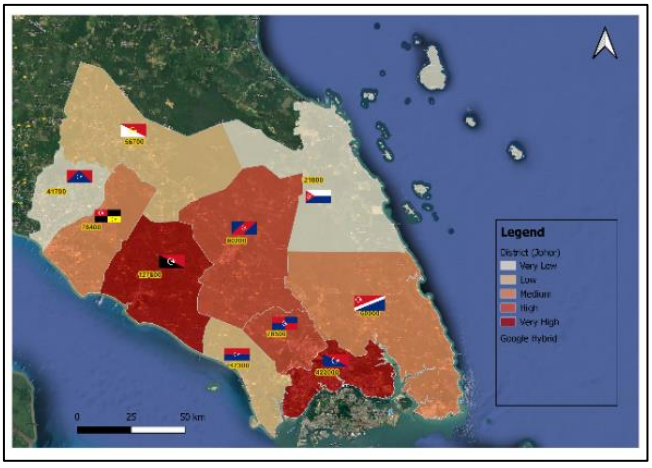

Figure 6: Spatial Distribution of Socio-Economic Levels Across Districts in Johor, Malaysia (2017)

Figure 2 to figure 6 shows that the spatial distribution of youth population across districts in Johor between 2017 until 2021.

4.3 Correlation with Industrial Zones

Spatial analysis revealed a robust relationship between youth population densities and industrial zones. Industrial areas like Pasir Gudang and Iskandar Malaysia are not only employment hubs but also catalysts for demographic shifts. Youth are drawn to these zones due to job availability in manufacturing, technology, and services, which often offer competitive wages and career progression opportunities. The findings underscore the strategic role of industrial development in shaping population dynamics and highlight the potential of these zones to serve as focal points for youth-centric growth strategies.

The findings of this study have significant implications for urban planning, highlighting the need to address the unique needs of the youth demographic, particularly in urban centers like Johor Bahru. With a high concentration of young individuals, urban planners must prioritize the development of affordable housing, efficient public transportation networks, and recreational facilities. These amenities are essential for fostering a high quality of life and encouraging long-term residency among the youth. Additionally, creating inclusive and safe urban environments is crucial to ensuring community engagement and social cohesion. Smart city initiatives and investments in sustainable infrastructure, such as energy-efficient buildings and integrated public services, can further enhance urban livability and accommodate the growing demands of a youthful population.

The study underscores the pivotal role of economic opportunities in attracting and retaining the youth population. Employment prospects in high-growth sectors like manufacturing, technology, and services remain a primary drive for youth migration to urban and industrial hubs. To build on this momentum, policies must focus on promoting job creation, fostering entrepreneurship, and enhancing the innovative ecosystem. Investments in education and vocational training are equally important, equipping young individuals with the skills needed to thrive in these competitive sectors. Aligning economic development strategies with the aspirations of the youth demographic is key to ensuring sustainable economic participation and regional growth.

However, the concentration of youth in urban centers also highlights the pressing need to address regional disparities. Rural areas, often facing challenges such as workforce depletion and limited access to opportunities, require targeted interventions to bridge the urban-rural gap. Investments in rural infrastructure, such as transport networks and digital connectivity, can create new economic opportunities and improve the standard of living. Initiatives to develop local industries and enhance access to quality education and healthcare are essential for retaining and attracting youth in rural regions. By reducing socio-economic inequalities between urban and rural areas, policymakers can achieve more balanced regional development.

Johor, Malaysia, has emerged as a significant hub for industrial development, driven by its strategic location, robust infrastructure, and economic growth. Key industrial zones in the region include Iskandar Malaysia, a large economic zone aimed at attracting investments in manufacturing, logistics, and technology, benefiting from high-quality infrastructure and proximity to Singapore (Top Johor Factory, 2024). Diagram 7 shows that Pasir Gudang is one of the largest industrial areas in Malaysia, covering over 400 square kilometers and hosting more than 700 factories that focus on industries such as petrochemicals, shipbuilding, and engineering. This area is strategically located near Pasir Gudang Port, facilitating import and export activities (Johor Industrial Space, n.d.).

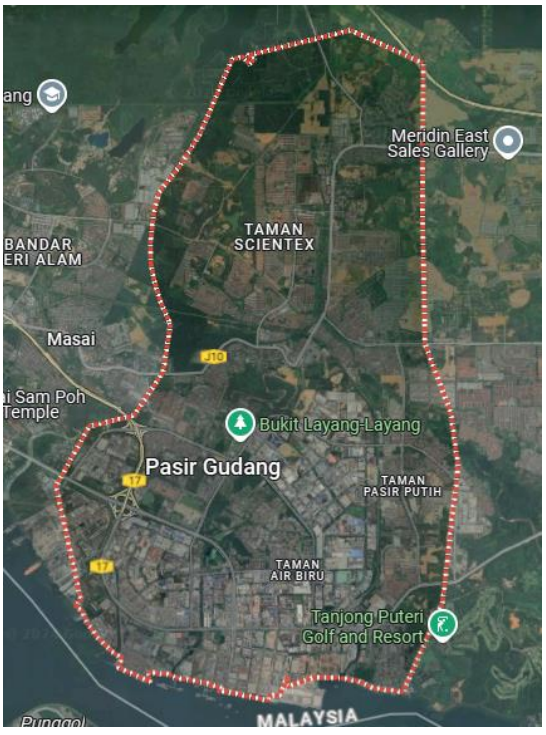

Figure 7: Pasir Gudang Industrial area

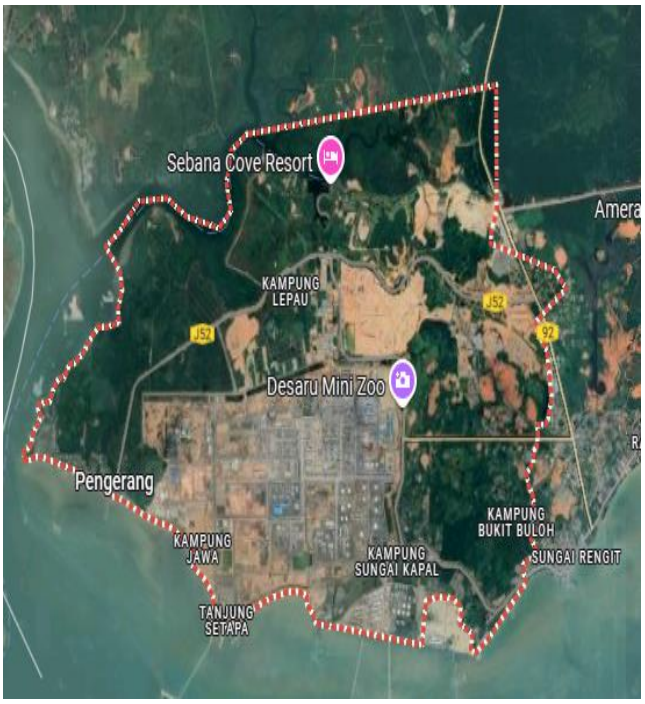

Figure 8: Pengerang area

Figure 9: Tanjung Langsat

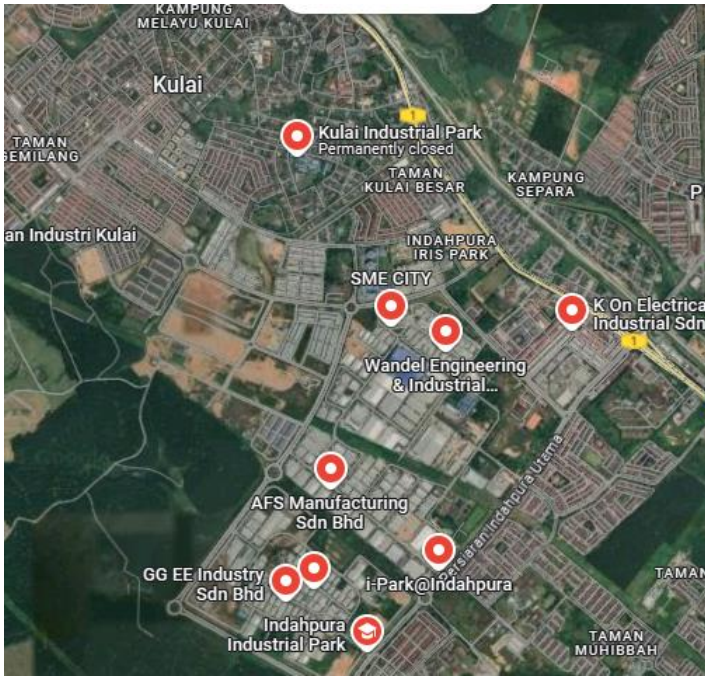

Figure 10: Kula

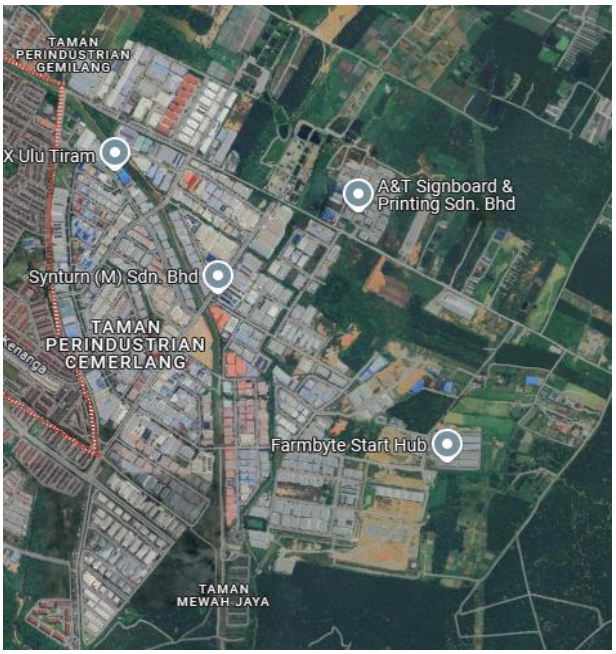

Figure 11: Desa Cemerlang

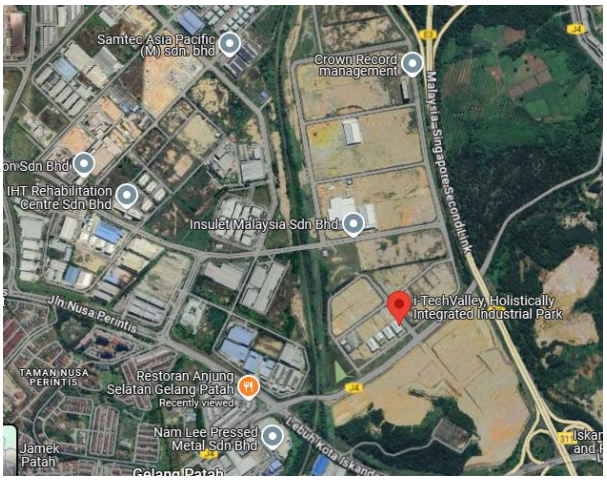

Figure 12: I TechValley (Iskandar Malaysia)

Another notable area is the Pengerang Integrated Petroleum Complex (PIPC) as shown in figure 8, which serves as a major hub for the oil and gas industry in southeastern Johor, housing refineries and petrochemical plants (Azmi and Associates, 2023). Figure 9 shows that the Tanjung Langsat Industrial Complex specializes in petrochemicals and heavy industries, supported by Tanjung Langsat Port for logistics and distribution. Kulai Industrial Park as shown in diagram 10 is well-established with diverse industries including manufacturing and logistics, enhanced by its proximity to Senai International Airport (Law Partnership, 2024).

Senai itself is witnessing significant industrial growth, attracting various sectors including light industries and logistics. Emerging areas like Desa Cemerlang as shown in figure 11 offer modern infrastructure suitable for light to medium industries such as food and pharmaceuticals. The Tebrau/Tampoi area emphasizes manufacturing and logistics due to its strategic location near major transportation routes. Kota Tinggi provides excellent connectivity to highways and is strategically located near the CIQ checkpoint for efficient cross-border trade. Finally, i-TechValley in diagram 12, part of Iskandar Malaysia, focuses on sustainable industrial development, attracting eco-friendly businesses. In conclusion, Johor's industrial zones present significant opportunities for investment across various sectors. The combination of strategic location, competitive costs, and government incentives positions Johor as a prime destination for industrial property investment in Southeast Asia.

Finally, the study demonstrates the critical role of advanced GIS tools, statistical models, and remote sensing technologies in understanding population dynamics. These tools provided precise and actionable insights into youth population distribution and their correlation with industrial zones. The methodological approach adopted in this study can be replicated in other regions to analyze different demographic groups,

offering valuable insights for policymakers and urban planners. Embracing technology and innovative analytical methods is crucial for effectively addressing demographic trends and supporting evidence-based decision-making.

5. Conclusion

The mapping of the spatial distribution of the youth population in Johor, Malaysia, from 2017 to 2021 using GIS tools offers significant insights into demographic trends and regional characteristics. By employing a systematic methodology that integrates demographic data with advanced GIS techniques, this study effectively highlights the patterns of youth population distribution across Johor.

The findings reveal critical areas with high concentrations of youth, as well as regions experiencing demographic shifts that may require targeted interventions. Understanding these spatial dynamics is essential for local policymakers and community planners, as it enables them to tailor programs and services to meet the specific needs of the youth population. Furthermore, the integration of socio-economic factors into the analysis provides a comprehensive view of how education access, employment opportunities, and urbanization influence youth demographics.

This research underscores the importance of utilizing GIS tools in demographic studies, facilitating a more nuanced understanding of population distributions. By validating these findings through field verification and engaging local stakeholders, the study enhances reliability and relevance. Ultimately, this work contributes to informed decision-making processes aimed at improving youth engagement and development initiatives in Johor, fostering a more inclusive and supportive environment for young people in the region.

In conclusion, the application of GIS in mapping youth populations not only enriches our understanding of demographic trends but also serves as a vital resource for addressing the challenges faced by youth in Johor, ensuring that their voices are heard, and their needs are met in a rapidly changing socio-economic landscape.

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